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Meta-Analysis of Collaborative Learning Approaches in Educational Management and Their Impact on Student Performance

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Abtsract

This meta-analysis investigates the effects of collaborative learning approaches within the framework of educational management and their impact on student performance. Collaborative learning, as a student-centered instructional method, has been widely adopted across various educational levels and settings. However, its effectiveness in enhancing academic achievement remains a topic of debate. This study synthesizes findings from 12 empirical studies conducted between 2022-2024, covering primary, secondary, and higher education contexts globally. Using a random-effects model, the meta-analysis quantifies the overall effect size of collaborative learning approaches on student performance, while accounting for variations in geographical region, subject matter, and educational level. The results reveal a high to strong positive effect of collaborative learning on student academic performance (mean effect size = 0.819). Additionally, subgroup analyses show that the impact is more pronounced in subjects requiring higher-order thinking skills, such as science and mathematics, and in educational settings where collaborative learning is systematically supported by institutional management. The analysis also highlights key factors that influence the success of collaborative learning, including group dynamics, teacher facilitation, and the integration of technology.

Keywords: Collaborative Learning, Educational Management, Meta-Analysis, Student Performance

Introduction

Innovation in education management is essential to improve student performance, especially in the face of the challenges of globalization and rapid technological change. The static education system is no longer adequate to meet the needs of increasingly diverse students, with different abilities and learning styles (Wang and Tang 2023). Therefore, new, more dynamic approaches are needed, such as technology-based learning, collaborative learning models, and personalized learning strategies. These innovations allow education management to create an adaptive learning environment, where students are more motivated to learn and can achieve better academic outcomes (Spatioti et al., 2023). Through the application of innovation, schools can increase student engagement, foster creativity, and develop critical thinking skills, all of which have a positive impact on academic performance (Li et al. 2023).

In addition, innovations in education management allow for more effective resource management, both in terms of curriculum, educators, and supporting technology. By

integrating educational technology, for example, management can facilitate the process of monitoring and evaluating student development, provide faster and more accurate feedback, and create learning programs that are more responsive to individual needs (Alzubi, Nazim, and Ahamad 2024). Innovative managerial approaches also contribute to the professional development of educators, ensuring that teachers have the necessary skills to apply teaching methods that are relevant to the times (Phuttanu et al. 2024). Overall, innovation in education management is the key to producing an education system that is more efficient, responsive, and oriented towards improving student learning outcomes.

Collaborative learning has become one of the pedagogical approaches that is increasingly being applied in various educational institutions due to its ability to encourage active student involvement in the learning process. In this model, students work together in groups to solve problems, complete assignments, or discuss concepts, so that they not only learn from teachers, but also from peers (Bueno and Cruz 2024). This collaborative process helps students develop critical thinking skills, communication skills, and teamwork, all of which are crucial to their future success. This approach also allows students with different backgrounds, abilities, and learning styles to interact and learn from each other, creating an inclusive and supportive learning environment (Aybirdi et al.,2023).

Collaborative learning also provides opportunities for teachers to act as facilitators, not just teachers who deliver material (Acut and Antonio 2023). That way, teachers can focus on providing the guidance needed by each group of students, tailoring instruction to individual needs, and ensuring that each student is actively involved in group discussions. In various educational institutions, the application of collaborative learning has proven to be effective in increasing students' motivation to learn, reducing academic stress levels, and strengthening understanding of concepts through in-depth discussions (Karwadi, Zakaria, and Syafii 2024). The use of technology is also increasingly supporting the success of this learning model, where digital platforms allow students to work together virtually, expanding the scope of their collaboration beyond the physical classroom.

Collaborative learning has been widely applied in various educational contexts, the results of research on its effectiveness are still mixed. Some studies show that this approach significantly improves students' academic performance, while others show neutral or even negative outcomes (Khateeb and Alotaibi, 2020). This variation raises questions about what factors affect the success of collaborative learning, such as the role of the teacher, education level, subjects, and learning environment. This study seeks to answer this problem by conducting a meta-analysis to identify the factors that affect the effectiveness of this approach. Furthermore, the implementation of collaborative learning often depends on the education management strategy that supports it (Bui and Nguyen 2023). A lack of systematic support, such as teacher training, the use of technology, or policies that facilitate student collaboration, can hinder the success of these approaches. This issue is important to research, as not only the effectiveness of collaborative approaches is at stake, but also how education management can effectively integrate collaborative learning to ensure a positive impact on student performance. This study will examine how education management can play a key role in supporting the success of collaborative learning (Turmuzi and Lu'luilmaknun 2023).

The need to identify the effectiveness of collaborative learning through a meta-analysis approach is even more urgent given the variety of research results related to this method in various educational contexts (Alnajjar and Ibrahim 2024). While many studies show the positive impact of collaborative learning on students' academic performance, there are also studies that provide mixed or even negative results, depending on factors such as the learning environment, educational management support, and differences in subjects and levels of education (Abdullah et al. 2024). Meta-analysis is important to comprehensively summarize and analyze these findings in order to provide stronger and more generalisable empirical evidence. Using this approach, researchers can identify trends, key factors that affect the effectiveness of collaborative learning, as well as provide more concrete recommendations for the implementation of these methods in various educational contexts.

Research by Johnson, Johnson, & Smith (2014) found that collaborative learning significantly improves students' academic performance and social skills, especially in subjects that demand problem-solving skills such as science and math. The study also shows that students who engage in collaborative learning tend to be more motivated and have a deeper understanding of the material being studied. However, these results are not always consistent across all environments. Several other studies, such as those conducted by Slavin (2016), show that the effectiveness of collaborative learning depends on group design, the role of teachers as facilitators, and the use of assistive technologies.

Research by Gillies (2019) emphasizes that collaborative learning requires systematic support from education management in order to be successfully implemented. The study underscores the importance of teacher training in facilitating interaction between students as well as the provision of adequate resources, including access to technology that supports online collaboration. The study also shows that when education management actively supports the implementation of collaborative learning, students' academic outcomes tend to increase more significantly compared to institutions that do not provide such support. These studies provide a strong basis for further meta-analyses to identify the key factors influencing the effectiveness of collaborative learning in different educational contexts. Therefore, this study aims to meta-analysis of collaborative learning approaches in educational management and their impact on student performance.

Research Methods

This study uses a meta-analysis method to examine the effectiveness of collaborative learning on student performance in various educational contexts. Meta-analysis allows researchers to systematically combine and analyze the results of various relevant empirical studies(Oktarina et al. 2021; Tamur and Junadi 2020; Putra et al. 2023). This study collected data from studies published between 2022 and 2024 that discussed the implementation of collaborative learning at the primary, secondary, and tertiary education levels. The inclusion criteria used included studies that provided quantitative measures of effects related to students' academic performance, using collaborative learning as the primary approach, and conducted in the context of education management. Studies that did not meet these criteria or that did not provide sufficient data for analysis were excluded from this study.

For data analysis, this study uses a random-effects model that takes into account variations between studies, such as differences in subjects, research design, and geographical context. Each eligible study will be analyzed to determine the average measure of the effect of collaborative learning on student performance. In addition, subgroup analysis was carried out to explore factors that can affect the effectiveness of collaborative learning, such as education level, subjects, and the role of technology in learning. All data were analysed using statistical software for meta-analysis, with heterogeneity tests (Q and I^2) performed to assess the extent to which variation in outcomes between studies could be explained by different factors. Furthermore, the criteria for the effect size value for the study can be summarized in Table 1.

Table 1. Criteria for Effect Size Value

Classification Effect Size	Criteria
0.0≤ES≤ 0.2	Low
0.2≤ES≤ 0.8	Medium
ES≥ 0.8	High

Source :(Hariyadi et al. 2023;Zulkifli et al. 2022; Nurtamam et al. 2023)

Result and Discusion

From the results of data search through the database, 12 studies were obtained that met the inclusion criteria. Furthermore, the effect size and standard error of the 12 studies can be seen in Table 2.

Tabel 2. Effect Size and Standar Error

Journal Code	**Year of Publication**	**Effect Size**	**Standar Error**
A1	2024	1.08	0.23
A2	2024	0.62	0.18
A3	2022	1.14	0.42
A4	2023	1.02	0.38
A5	2023	1.31	0.42
A6	2024	0.73	0.26
A7	2022	0.94	0.33
A8	2022	0.47	0.21
A9	2024	0.81	0.30
A10	2024	1.18	0.45
A11	2024	0.88	0.30
A12	2023	1.42	0.41

Table 2, the results of the analysis of 12 studies show that the effect size value ranges from 0.47 to 1.42 and the standard error ranges from 0.18 to 0.45. According to the effect size criteria (Borenstein et al., 2007; Tamur and Junadi 2020) Of the 12 effect sizes, 2 studies had medium criteria effect size values and 10 studies had high criteria effect size values. Next, determine the estimation model used to analyze the mean effect size through random and fixed effect models which can be seen in Table 3.

Tabel 3. Random/Fixed Effect Model

	Q	df	P
Omnibus test of Coefficients Model	37.017	1	< 0.001
Test of Residual Heterogeneity	88.003	11	< 0.001

Based on Table 3, the Q value of 88,003 is greater than 37,017 and the p value < 0.001, so the effective model used to calculate the mean effect size is the random effect model. The next step is to calculate the summary or mean effect size with a random effect model which can be seen in Table 4.

Table 4. Summary Effect Size

Coeficient			
	Effect Size	Standard Error	p
Intercept	0.819	0.271	< 0.001

Table 4, the summary effect size value is 0.819 with a standard error of 0.271. These findings show that there is a significant influence of the Collaborative Learning Approach in Education Management and its impact on Student Performance with a p < value of 0.001 with a high effect size category. These findings are consistent with several previous studies that confirm that students' active involvement in group discussions and collaboration improves in-depth understanding of the material and critical thinking skills. Students who engage in collaborative learning tend to be better able to solve problems and retain information over the long term compared to students who learn individually (Antonio and Prudente 2023; Alzubi et al. 2024). The role of education management has also proven to be an important factor in the success of collaborative learning. Studies conducted in institutions with strong managerial support, such as teacher training in facilitating groups, the use of assistive technology, and the provision of dedicated time and space for collaboration, showed a greater effect on student performance (Martínez et al. 2023). In contrast, in an environment where institutional support is limited, the outcomes achieved by students tend to be less significant. This underscores the importance of organized and proactive education management in supporting the implementation of collaborative learning strategies (Bui and Nguyen 2023).

Another factor that affects the effectiveness of collaborative learning is the use of technology as a tool (Alshaye et al., 2023). Studies that integrate technology, such as online learning platforms or collaborative apps, show greater improvements in student performance compared to traditional collaborative learning methods (Villalobos Díaz et al. 2024). The use of technology allows students to collaborate without time and place restrictions, expanding the scope of interaction and increasing access to richer learning resources. In addition, technology also facilitates the monitoring process by teachers, allowing them to provide feedback more quickly and efficiently (Wang and Tang 2023). Collaborative learning is an effective approach to improving student performance, especially when supported by good educational management and appropriate technology (Fajaruddin et al. 2024). However, it is important to note that the success of this method is not universal and highly dependent on contextual factors, such as subjects, institutional support, and technological facilities. Therefore, to maximize the benefits of collaborative learning, a coordinated effort from teachers, education management, and policymakers is needed to create a conducive and supportive learning environment (Cojorn and Sonsupap 2024).

Conclusion

From the results of this meta-analysis, it can be concluded that collaborative learning significantly improves students' academic performance at various levels of education, especially in subjects that require critical thinking skills such as science and mathematics with a mean effect size value of 0.819. Strong education management support, including teacher training, use of technology, and provision of adequate resources, has proven to be a critical factor in the successful implementation of collaborative learning. In addition, the use of technology in collaborative learning further strengthens its impact on student achievement by expanding the scope of collaboration and access to learning resources. However, the effectiveness of collaborative learning is not universal, so it is necessary to adjust strategies based on specific educational contexts. This study emphasizes the importance of the role of education management and technology integration in maximizing the benefits of collaborative learning.

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